中国光伏产业与技术发展现状及趋势

Status and Trends of PV Industry and Technology in China

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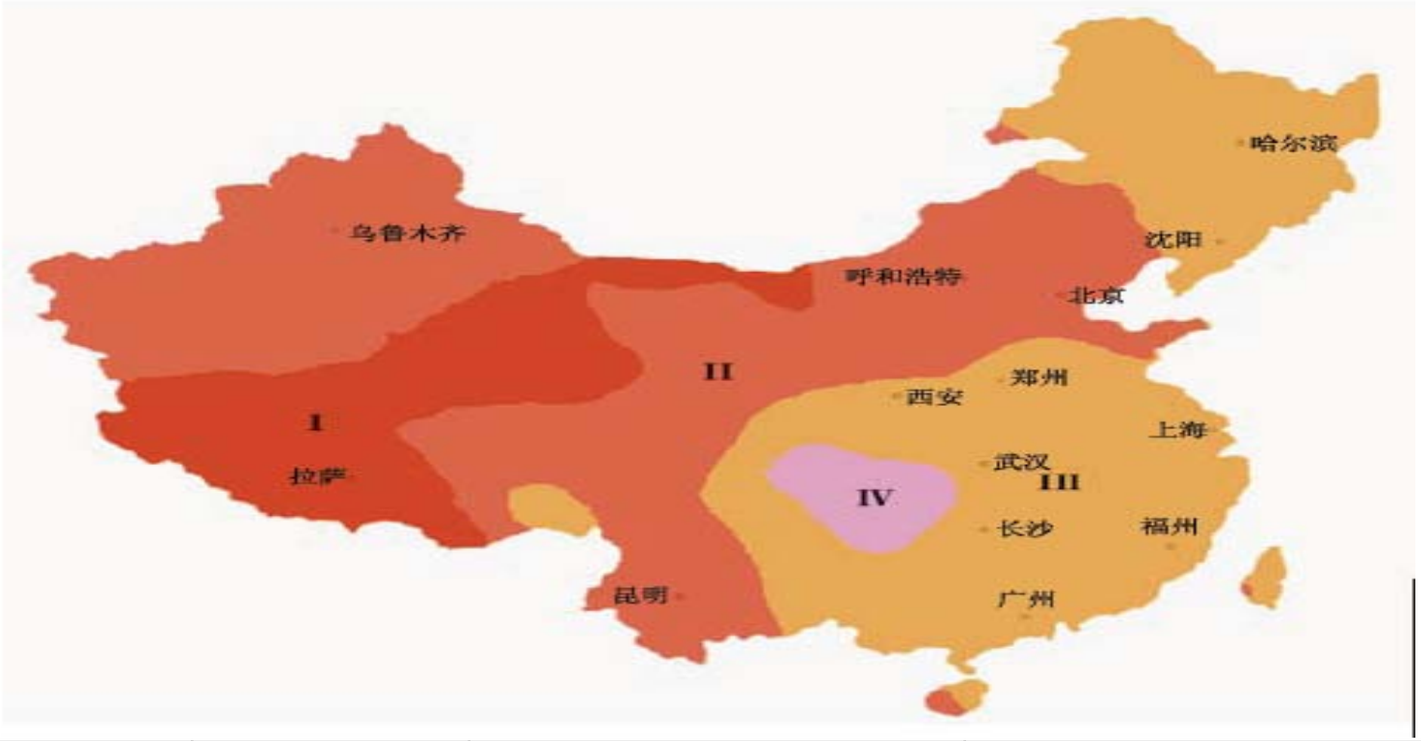
一、中国光伏产业发展现状及趋势(1)— 太阳能资源潜力

1. Status and Trends of PV Industry in China (1) — Solar Energy Resources



- 三分之二的国土面积年日照小时数在2200小时以上；

Two-thirds of the land area of 2200 hours of annual sunshine hours

- 平均年太阳辐射总量大于每平方米5000兆焦。

Average annual total solar radiation is greater than 5000 MJ per square meter

等级 Grade	资源带号 Number of resources	年总辐射量（MJ/ m²） Total radiation	年总辐射量（kWh/ m²） Total radiation	平均日辐射量（kWh/m²） Average daily radiation
最丰富带	I	≥ 6300	≥ 1750	≥ 4.8
很丰富带	II	5040 – 6300	1400 – 1750	3.8 – 4.8
较丰富带	III	3780 – 5040	1050 – 1400	2.9 – 3.8
一般	IV	< 3780	< 1050	< 2.9

一、中国光伏产业发展现状及趋势(2)— 光伏产业整体现状

1. Status and Trends of PV Industry in China (2) — Status of the PV Industry

- **产业高速增长**:10年中国电池产量***870万千瓦***,占世界的50%,连续四年居世界首位
  PV cell production in 2010 is 8.7 GW, which is 50% of the world. China ranks first in the world in past four years
- **国内市场启动:**10年累计装机800MW(新增500MW), 比09年增长***167%***
  Cumulative installation in 2010 is 800MW(500MW new), which is 1.67 times of the number in 2009
- **产业链条形成:**10年多晶硅材料***自给率50%***(07年仅10%)
  50% of Poly-silicon material is provided by Chinese company (only 10% in 2007)

中国太阳电池年产量和年装机比较（MWp）

The Contrast of PV Cell Annual Output and Annual Installation

年	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
年产量（MW）	4.5	10	10	50	200	400	1088	2600	4000	8700
年装机（MW）	4.5	18.5	10	10	8	10	20	40	160	500

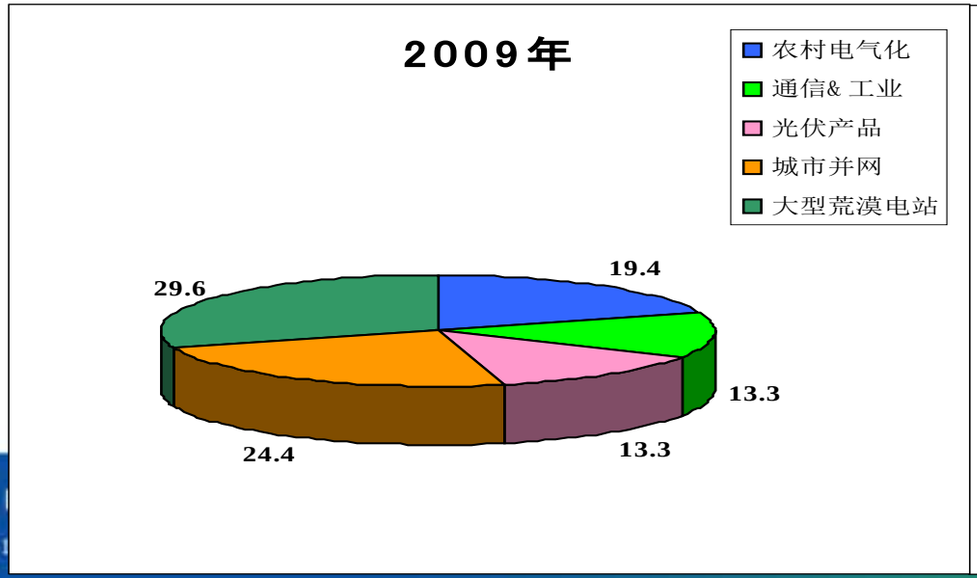
中国光伏发电利用水平远远落后,国内光伏产业严重依赖外国市场。

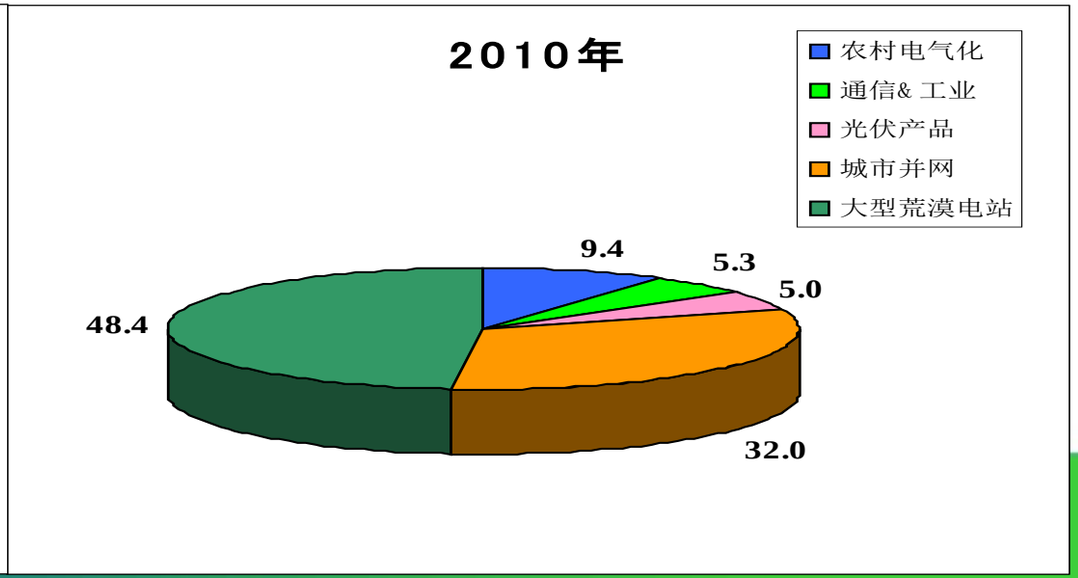
Application level of PV in China is still far behind, and the domestic PV industry strongly relies on foreign market.

一、中国光伏产业发展现状及趋势(3)— 光伏装机容量

1. Status and Trends of PV Industry in China (3) — PV Installed Capacity

光伏累计装机 2009 2009 PV Cumulative Installed Capacity			光伏累计装机 2010 2010 PV Cumulative Installed Capacity		
市场 Market	累计装机（MWp） Cumulative Installation	份额（%） Share	市场 Market	累计装机（MWp） Cumulative Installation	份额（%） Share
农村电气化 Rural Electrification	58	19.4	农村电气化 Rural Electrification	75	9.4
通信&工业 Communication and Industry	40	13.3	通信&工业 Communication and Industry	42	5.3
光伏产品 PV Products	40	13.3	光伏产品 PV Products	40	5.0
城市并网 BI(A)PV	73.1	24.4	城市并网 BI(A)PV	256	32.0
大型荒漠电站LS-PV in Gobi/Desert	88.9	29.6	大型荒漠电站LS-PV in Gobi/Desert	387	48.4
合计 Total	300	100	合计 Total	800	100





一、中国光伏产业发展现状及趋势(4)— 光伏产业发展趋势

1. Status and Trends of PV Industry in China (4) — PV Industry Development Trend

中国大规模发展光伏发电势在必行

Large-scale development of PV in China is imperative

- **实现20年装机目标**：2020年光伏装机**50GW**,从10年初至20年底,年均新增**5GW**

Target of 2020: PV capacity 50GW in 2020, annual new inatallation 5GW from 2010 to 2020

- **迈向光伏技术强国:**自主技术仍落后于世界先进水平、落后于市场发展

Technology's still lags behind the world advanced level and market development

- **促进节能减排目标:**20年非化石能源将达15%, GDP碳排放比05年下降40--45%

Promote energy conservation goals:Non-fossil energy will reach 15% , GDP carbon emissions decline by 40-45%

随着光伏发电大规模化发展，光伏成本下降，生产技术提高，产业链更加完善。

With the development of large-scale photovoltaic power generation, PV costs will decline, production technology gradually improve, industrial chain will be more complete.

二、中国光伏技术发展现状及趋势(1)— 太阳电池技术现状

2. Status and Trends of PV Technology in China (1) —— Status of PV Cell

❑ 中国太阳电池技术现状 Technology status of PV cell

- 晶硅电池：效率仍有提升空间，产业链高端生产设备主要依赖进口

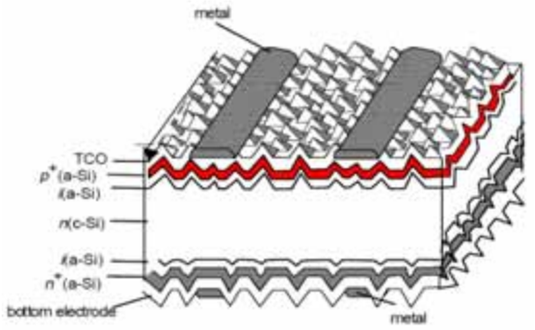
  For crystalline silicon cells: efficiency and cost are still main problem to solve, and many equipments in production line still relis on import

- 薄膜电池：硅基薄膜电池生产线仅20余家，碲化镉和铜铟镓硒等尚无规模化生产线

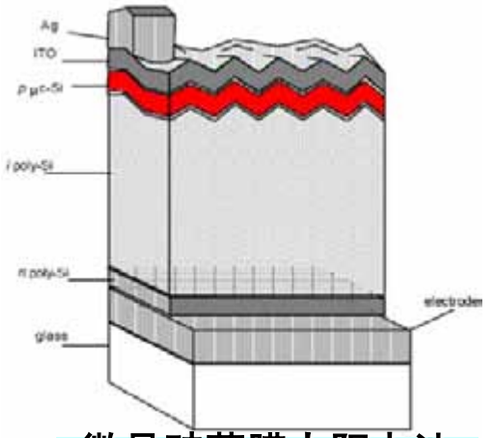
  For thin-film cell: Silicon-based thin-film cell production line only 20 manufacturers, there is no large-scale production lines of CdTe and CIGS

- 其他电池：有机电池、聚光电池研制刚刚起步，第三代电池仍处在理论研究阶段

  Other cell: Organic cell、concentrator cells just started, third-generation battery is still in the stage of theoretical research



HIT太阳电池
HIT Solar Cell



微晶硅薄膜太阳电池
Microcrystalline silicon thin-film cell

电池装配生产线
Cell assembly line

二、中国光伏技术发展现状及趋势(2)— 各种太阳电池效率

2. Status and Trends of PV Technology in China (2) — Solar Cell Efficiency

实验室效率
Solar Cell Efficiency in Lab

	国外 International		国内 Domestic	
太阳电池类型 Solar cell	最高效率 Maximum efficiency	研究单位 Research units	最高效率 Maximum efficiency	研究单位 Research units
单晶硅电池 Mono-silicon	25%	新南威尔士大学（PERL）	20.4%	天津电源研究所
多晶硅电池 Poly-Crystalline Si	20.3%	德国弗赖堡太阳能系统研究所	18%	无锡尚德太阳能电力有限公司
GaAs电池	42.3%	美国Spire Semiconductor	29.25%	天津电源研究所
CIGS	20.3%	德国太阳能与氢研究中心(ZSW)	14.3%	南开大学
CdTe	16.7%	美国国家能源实验室	13.38%	四川大学
染料敏化电池 Fuel-sensitized solar cells	11.1%	日本夏普	8.1%	中科院长春应化所
HIT	23%	日本三洋电机	17.27%	中科院研究生院

国内外商业化效率对比
Compare of Commercial Solar Cell

国外 International		国内 Domestic	
单晶硅太阳电池 Mono-silicon	22%	单晶硅太阳电池 Mono-silicon	19%
多晶硅太阳电池 Poly-Crystalline Si	16.9%	多晶硅太阳电池 Poly-Crystalline Si	16%
三结非晶硅电池 A-Si	8~10%	双结或单结非晶硅电池 A-Si	6~7%
CIGS	15.7%		
CdTe	8~10%		
高效黑电池 Black Cell	>20		
HIT	>20		
GaAs	>26（空间用）		
带硅电池 Silicon Ribbon Solar Cell	>15		

二、中国光伏技术发展现状及趋势(3)— 大型荒漠光伏电站

2. Status and Trends of PV Technology in China (3) — Large Scale PV Plant

- 中国大型并网光伏电站发展非常迅速
  In China, the large scale PV plants develop very fast
  - 最大：徐州20MW　　10MW以上数十座
    The largest one is XUzhou Xiexin 20MW, 10MW PV plant is more than ten.


甘肃敦煌10MW光伏电站
Gansu Dunhuang 10MW PV


宁夏石嘴山10MW光伏电站
Ningxia Shizuishan 10MW PV


宁夏太阳山10MW光伏电站
Ningxia Taiyangshan 10MW PV


徐州协鑫20 MW（2010年）
XUzhou Xiexin 20MW PV(2010)

二、中国光伏技术发展现状及趋势(4)— 建筑光伏系统

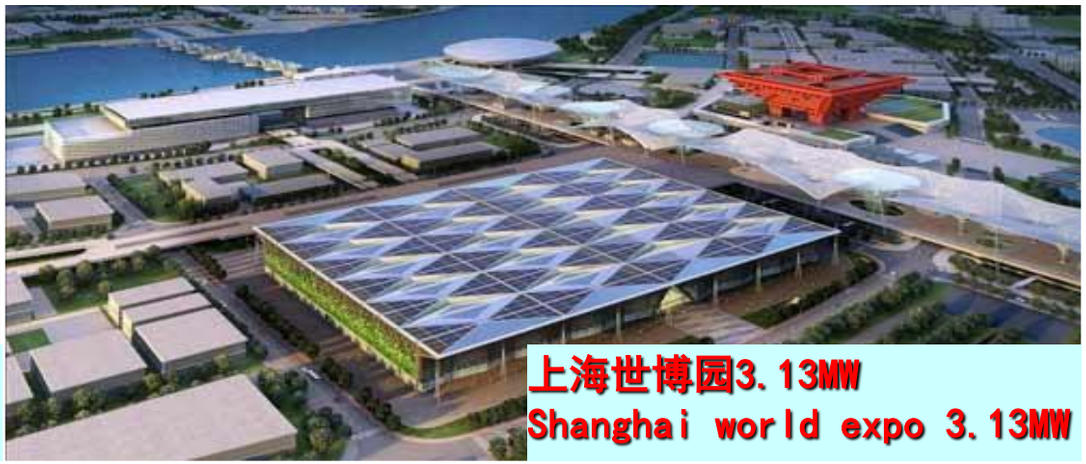
2. Status and Trends of PV Technology in China (4) — BAPV/BIPV

- 中国城市并网光伏系统发展较快
  BIPV develop rapidly
- 最大：上海世博园3.13MW　　首座MW级：深圳园博园1MW
  The largest one is Shanghai world expo 3.13MW BIPV

浙江义乌1.295MW
Zhejiang Yiwu 1.295MW

深圳园博园1MW
Shenzhen 1MW

武汉火车站2MW
Wuhan train station 2MW



上海世博园3.13MW
Shanghai world expo 3.13MW

二、中国光伏技术发展现状及趋势(5)— 多能互补微网发电系统

2. Status and Trends of PV Technology in China (5) — Micro-grid

◆光/水互补微网：与现有水电结合，解决水力资源不足或冬季运行受限

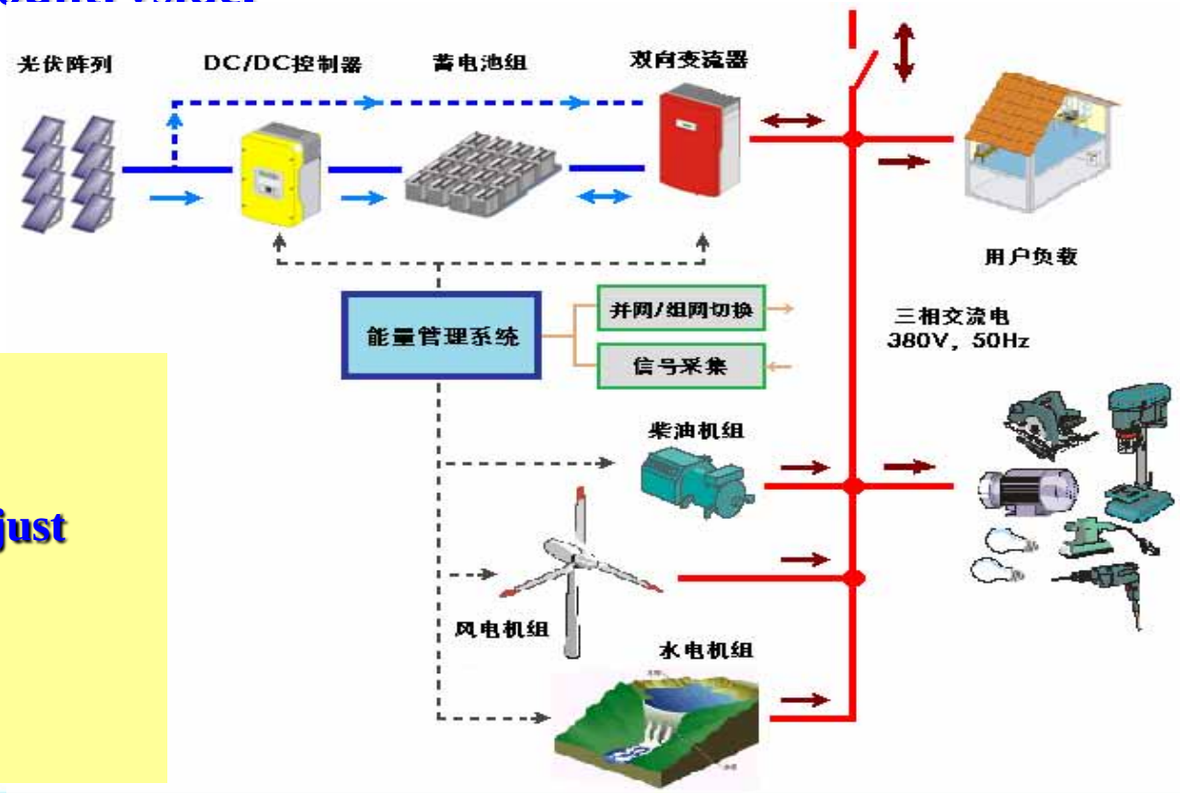
PV/hydro hybrid micro grid: To solute the problem of hydro-power shortage or hydro-power's capacity limit in winter.

◆典型项目：（10MW级）西藏阿里，青海玉树，其他县、乡级光/水互补等

Typical Project: Several 10 MW-class PV/hydro hybrid generation systems are constructing in Ngari Tibet, Yushu Qinghai, and other countryside.

青海玉树10MW光伏场址

The site of Yushu 10MW



现状Status：

❖光/水互补发电技术刚起步，产品空白；

The research on PV/hydro hybrid generation is just beginning, and no product is available

❖目前国内尚无该类示范系统。

No demonstration is constructed in China, now.

二、中国光伏技术发展现状及趋势(6) — 集中型光伏逆变器

2. Status and Trends of PV Technology in China (6) — Centralized PV Inverters

◆ **集中型光伏并网逆变器：已研制出1MW逆变器**

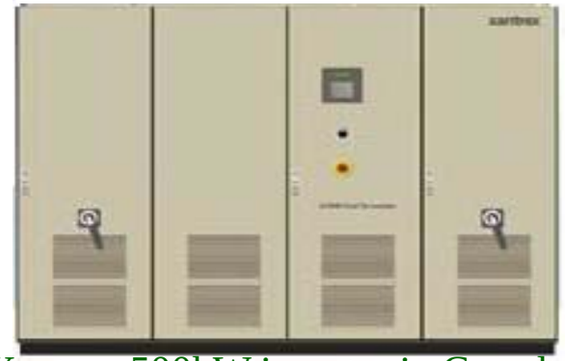
Centralized inverter: 1MW inverters are being developed

—国外：最大容量2MW（西门子），系列控制逆变技术与设备比较成熟，已商业化应用

International: The maximum is 1.5MW, Series inverter control technology and equipment is more mature, has commercial applications

—国内：最大容量≥1MW（合肥阳光、科诺伟业、电工所等），尚需长期考核运行和改进完善

Domestic: The maximum is ≥1MW, Still need long-term operation and refinement of assessment



Xantrex 500kW inverter in Canada

SMA 1MW inverter (2×500kW)

SMA 1.25MW inverter

150kW(06年)、500kW(08年)inverters（IEE、Beijing Corona）

（2×630kW）MW-class Power total solution（09年，Sungrow）

二、中国光伏技术发展现状及趋势(7)—光伏自动跟踪系统

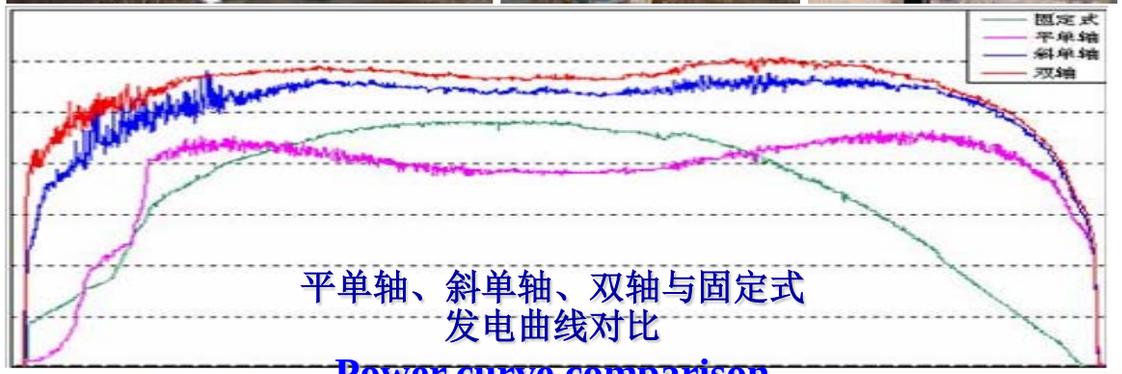
2. Status and Trends of PV Technology in China (7) — Solar Tracking System

—国外：光伏自动跟踪装置已较成熟，已商业化应用

International: Solar traking system is more mature, has commercial applications

—国内：双轴单机10kW、斜单轴单机10kW、平单轴单机50kW ，开始小批量应用

Domestic: The largest of double-axes is 10kW, tilted-latitude single axis is 10kW， horizontal single axis is 50kW



平单轴、斜单轴、双轴与固定式
发电曲线对比

Power curve comparison

三、中国光伏发展激励政策(1)— 金太阳示范工程

3. Government PV Incentive Policies (1) — Golden Solar Project

2009年7月，出台了《金太阳示范工程财政补助资金管理暂行办法》

In 16th July, 2009, The "Golden Solar Program " is published.

总体思路General Principle

- 总规模不小于500MWp The total scale should not be less than 500MWp
- 拉动光伏发电产品内需市场With the purpose of promoting the domestic PV products demands
- 可再生能源专项资金补贴Subsidized by RE special fund
- 推进自主知识产权光伏发电系统技术和产品的规模化应用——要求100%国内技术 To promote the PV technologies independent intellectual property rights development and their large scale application - 100% domestic technology is necessary
- 快速提升我国光伏发电相关产业技术创新和竞争力——建立产品检测和认证体系，保证产品质量 To upgrade the domestic PV technology innovation and competitive capability quickly – to establish testing and accreditation system
- 科技部提供技术支撑和技术的持续改进The technology improvement will be supported by the MOST
- 电网建立相关并网及可靠性保准，监测系统发电情况 The standards related to grid connection and reliability will be established by the power grid

支持范围 Supporting Regions

1. 配电侧并网光伏发电系统PV systems connected to the grid by the power distribution side
2. 独立光伏发电系统 Stand alone PV systems
3. 输电侧并网大型光伏发电系统LS PV systems connected to the grid by the power transmission side
4. 光伏发电关键技术和产品产业化项目 Projects of PV powering key technology and products industrialization regions
5. 光伏发电产品及系统的标准制定和检测能力建设 Development of PV products & systems standards and the testing capacity building
6. 光资源详查和评价 Solar energy investigation and evaluation

2009年批准147MW，2010年批准272MW，并在全国建立13个光伏示范园区

147MW in 2009,272MW in2010,and install 13 solar demonstration parks

三、中国光伏发展激励政策(2)— 特许权招标

3. Government PV Incentive Policies (2) — PV Concession

特许权招标：未实行固定上网电价前，极大推动光伏市场开发。

PV concession : Before a fixed tariff is implemented, greatly promoting the development of PV market.

- 2009年3月第一批特许权招标仅敦煌1万kW光伏电站项目，中标电价为1.09元/kWh，2010年底已完工。2010年6月开始第二批光伏电站特许权招标，总规模28万千瓦，2010年10月开标，13个项目以最低报价0.7288-0.9907元/kWh中标。建设周期自协议生效起24个月，经营期25年。

In March 2009, the first concession only 10,000 kW photovoltaic power plant in Dunhuang project, bid price of 1.09 yuan / kWh, completed at the end of 2010. In June 2010, started the second batch of photovoltaic power plant concession bidding, the total size of 280,000kW, opening in October 2010, 13 projects at the lowest price 0.7288 ~ 0.9907 yuan / kWh bid.

- 特许权招标使我国光伏发电上网电价得到大幅度降低，从2008年4元/kWh到2010年1元/kWh以下。

Concession makes China's PV electricity price has been significantly reduced from 4 yuan / kWh in 2008 to 1 yuan / kWh or less in 2010.

三、中国光伏发展激励政策(3)— 上网电价

3. Government PV Incentive Policies (3) — Tariff of PV

光伏标杆上网电价：光伏市场蓬勃发展的标志

PV tariff: A sign of booming PV market.

- 2011年7月1日以前核准建设、年底前建成投产、尚未核定价格的太阳能光伏发电项目，上网电价统一核定为每千瓦时1.15元。

Solar photovoltaic power generation projects which approved before July 1, 2011 , put into operation before the end of this year, not yet approved the price, approved unified electricity price 1.15 yuan per kWh.

- 2011年7月1日及以后核准的太阳能光伏发电项目，以及今年7月1日之前核准但截至今年年底前仍未建成投产的太阳能光伏发电项目，除西藏仍执行每千瓦时1.15元的上网电价外，其余各地上网电价均按每千瓦时1元执行。

Solar photovoltaic power generation projects which approved on July 1, 2011 or later, and approved before July 1 this year but not put into operation before the end of this year, with the exception of Tibet continue to enforce the 1.15 yuan per kilowatt-hour tariff, the tariff according to the implementation of 1 yuan per kWh.

Thanks !